

3.3 Architectural Design of Major Project Structures

The major buildings associated with the project are the weather enclosure structure (WES), which encloses the retrieval confinement structure (RCS), packaging glovebox system (PGS) and FFS, and the interim storage shelter. Minor structures include storage units, a change trailer, an assay trailer, and miscellaneous portable support trailers and skids.

3.3.1 Weather Enclosure Structure

The WES is a commercial-grade structure $80 \times 110 \times$ approximately 35 ft high (see Figure 3-13). It is constructed of a prefabricated steel frame covered with an insulated fabric. The frame and cover attach to a structural steel floor called the facility floor structure.

- The major structures meet or exceed Life Safety Code requirements.
- The Life Safety Code Occupancy classification for the WES is “Ordinary Hazard, Special Purpose Industrial.”
- The Life Safety Code Occupancy classification for the Interim Storage Structure is “Ordinary Hazard Storage.”

The WES houses the RCS and the PGS (see Figure 3-13). The RCS and the PGS are the confinement structures for waste zone material retrieval, handling, sampling, and packaging operations. The WES also houses the retrieval excavator and other mechanical and electrical equipment that support waste retrieval operations. The support systems that supply ventilation, heating, cooling, lighting, etc., are also located inside the WES.

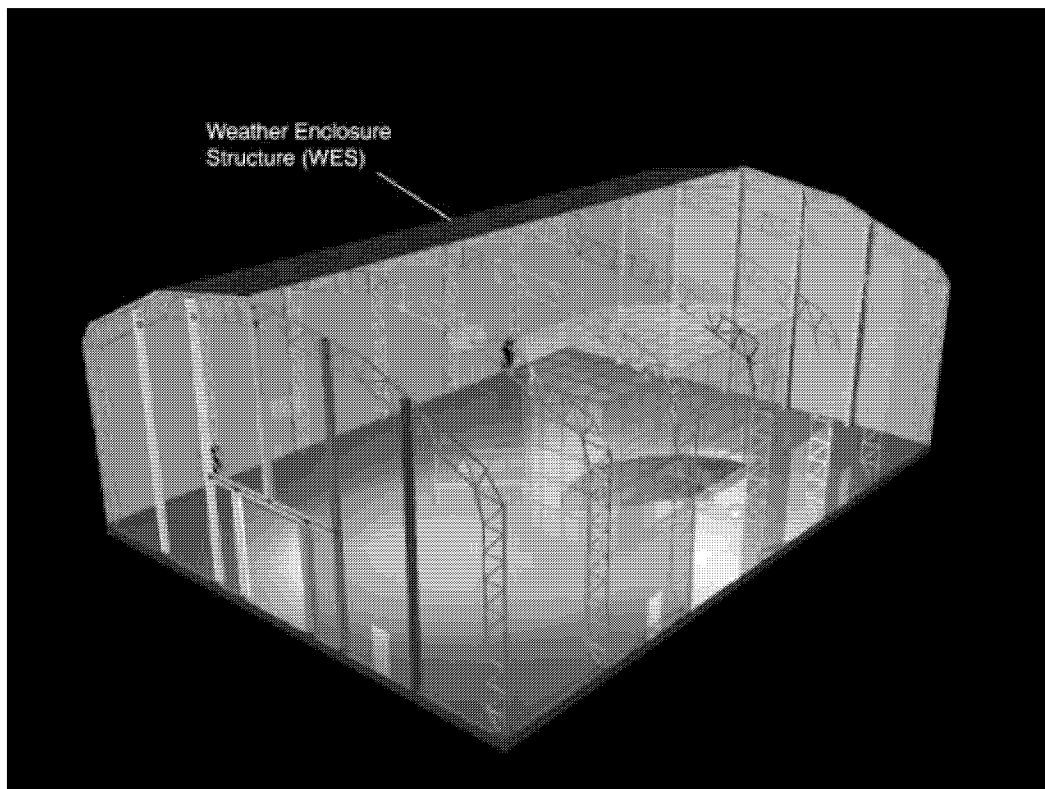


Figure 3-13. Weather enclosure structure housing the RCS and PGS.

Design Features. The WES has sufficient space for glovebox operations and waste drum movements (see Figure 3-14). The number and location of exit doors comply with the Life Safety Code (NFPA 101) and are designed to accommodate the approximately 24+ personnel who will work in the WES. The WES is also tall enough to accommodate the required construction and maintenance activities around the excavator, PGS, and RCS.

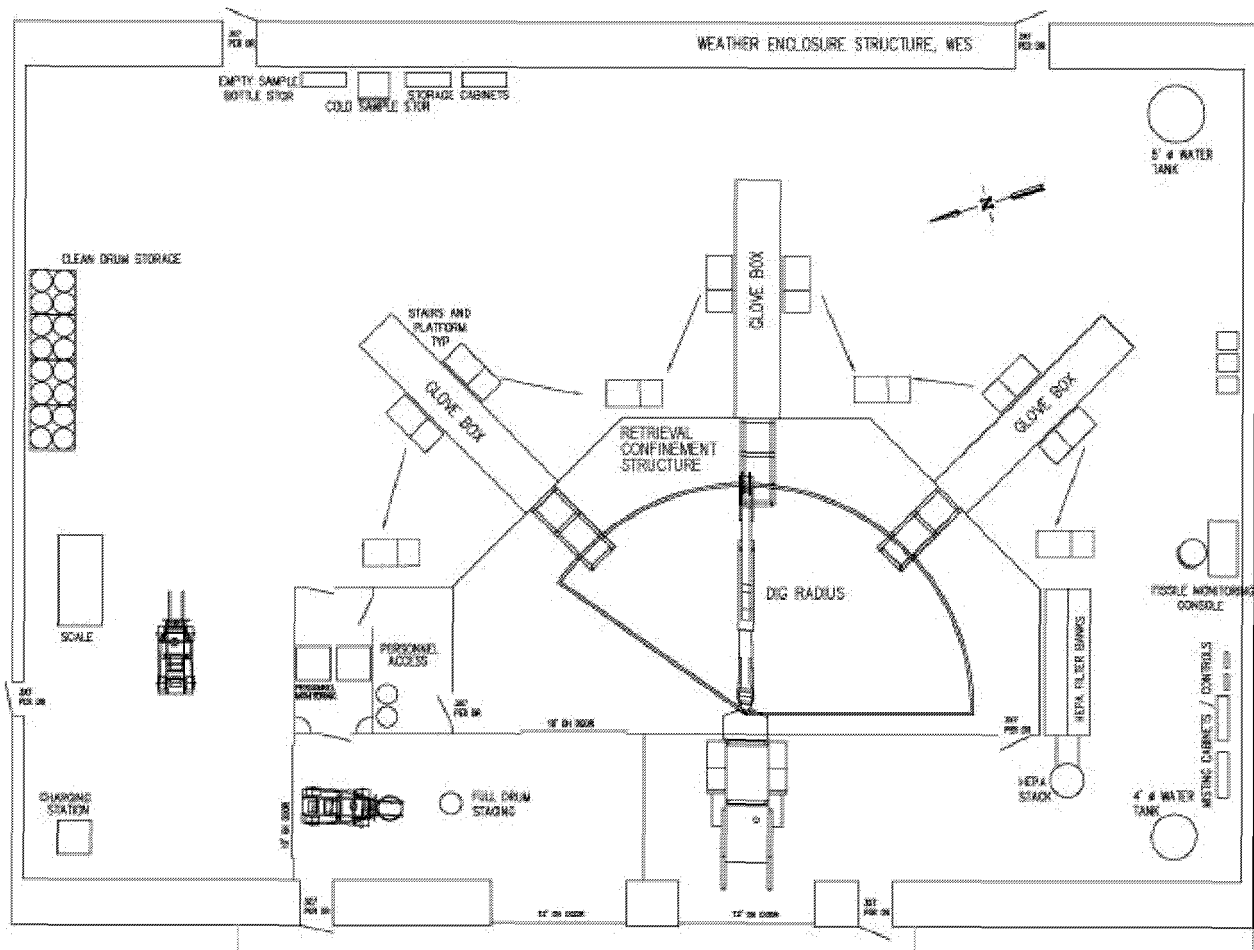


Figure 3-14. Weather enclosure structure has adequate space for glovebox operations and waste drum movements.

Architectural Features. The WES has five personnel doors and three vehicle doors (see Figure 3-14). A temporary vehicle door will be located on the north end of the structure to accommodate construction activities. Two vehicle doors located on the west side will accommodate positioning the excavator, and the other vehicle door is used for operational activities. Most of the personnel doors are emergency exits only and will not normally be used for operations. No windows are currently planned for the WES, but some of the personnel doors will have glazing. The outer shell is made of an insulated and fire-resistant PVC (polyvinyl chloride) fabric.

If erected early, the WES could also support construction activities in a protected environment during the winter months.

Life Safety Features. Refer to the preliminary Occupancy and Life Safety Code Analysis for life safety details. The Life Safety Code Occupancy classification for the WES is “Ordinary Hazard, Special Purpose Industrial.” The number of means of egress is within the required minimum and arranged for ready accessibility. Exits are properly illuminated and supplied with backup to remain illuminated for the required duration.

3.3.2 Interim Storage Shelter and the TSCA Trailers

The interim storage shelter and TSCA trailers are used for interim storage of waste drums coming from the PGS to protect them from the weather. The interim storage shelter consists of a relocated existing fabric structure manufactured by Sprung Structure Systems (see Figure 3-15).



Figure 3-15. External view of the interim storage shelter.

Design Features. The interim storage shelter, TSCA storage trailers, and other storage units are sized to store 500 waste drums consisting of 350 55-gal drums and 150 85-gal drums. The design includes aisle space for inspection activities and drum movements. The floor elevation of these structures will be above the local 100-year water surface.

Architectural Features. The interim storage shelter includes personnel entrance and exit doors, and one vehicle door. The fabric for the structure is fire-resistant.

Life Safety Features. The Life Safety Code Occupancy classification for the Interim Storage Structure is “Ordinary Hazard Storage.”

3.3.3 Other Structures

A change trailer is set up at the project site that houses personnel showers, lavatories, and change rooms. The change rooms include areas for donning and doffing PPE. Fire water, potable water, and sewer utility needs for this trailer will come from the existing RWMC systems.

Various other trailers, storage units, and skids provide support functions. The design of these normally unoccupied structures assumes entrance only for inspection or maintenance.

Design Features. The change trailer is sized to accommodate movement of approximately 24+ people per shift.

Architectural Features. Most of the other structures and trailers, except for the change trailer, have only one personnel door.

Life Safety Features. These structures comply with occupancy and life safety codes.

3.4 Structural Design

The main structures associated with the project are the RCS, and PGS. These structures are designed to safely confine the waste zone material retrieval and packaging processes. The weather enclosure structure assists in this confinement by protecting the confinement structures from weather conditions such as wind and snow. In order to provide safe confinement, the structures must also resist loading from operations, excavation, localized subsidence of the pit surface, and other events defined in the safety analysis.

Major safety significant structures comply with:

- DOE-ID Architectural Engineering Standards
- International Building Code
- Other applicable design specifications and codes.

The RCS and PGS are safety significant structures. The WES is designed to resist performance category (PC) 2 wind loading because it protects the safety significant structures and systems from the weather.

These major structural systems are designed to:

- Support applicable loading from personnel, equipment, waste drums, other structures, and support systems and components, including a higher level of loading from natural phenomena as required by applicable codes and standards.
- Safely confine the waste zone material, which also depends on other safety significant systems or components such as the fire protection system.
- Resist accidents or events such as sloughing of the excavation materials and subsidence of the pit surface.

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- Withstand negative pressures imposed by the ventilation system, including both a normal and maximum operating pressure.

Other project structures are the interim storage shelter and associated interim storage units or trailers, assay trailer, change trailer, utility skids, breathing air trailer, and instrument air trailers.

The major design standards, codes, and specifications used for the structures are the *DOE-ID Architectural Engineering Standards* (AES), *International Building Code* (IBC) and the American Institute of Steel Construction's (AISC) *Specification for Structural Steel Buildings—Allowable Stress Design*. Other AISC specifications such as the *LRFD Specification for Structural Steel Buildings* may also be used. The design loads and load combinations come from the IBC and AES.

3.4.1 Facility Floor Structure

The FFS design includes the framing and flooring for the weather enclosure floor and the shoring box through the overburden. Figure 3-16 shows the FFS framing plan. The floor structure covers approximately the same area as the WES (110 × 80 ft). The FFS is designed to support the WES, RCS, PGS, and other structures and equipment within the WES.

The main framing consists of structural steel, wide-flange shapes. The wide flanges rest on the pit's surface, but are designed to span at least 25 ft between support locations—the design span for a possible subsidence area. No support is assumed close to the excavation area. The main framing also supports the shoring box.

The preliminary design for the main flooring calls for 3-in. deep, 16-gage metal decking topped with a 3/16-in. plate that has a non-skid surface. Areas with high loads, such as the excavator support area, use a thicker plate; decking is not to be used in those areas.

The floor is the working surface for personnel, and supports small forklifts, pallet trucks, moveable platforms, and other relocatable equipment and instrumentation. Design loads include personnel, equipment, other structures, wind, and earthquake loads. The designed uniform live load is 100 lb/ft².

The shoring box is a steel structure similar in design to trench boxes commonly used for construction excavation, the main differences being the shape and size of the box (see Figure 3-16). The box provides the perimeter for the arc-shaped excavation area. The arc-shape has a 20-ft radius and has an angular dimension of 145 degrees. The box is made from structural tubing and steel plate. The box extends a maximum of 3.5 ft into the overburden.

The purpose of the shoring box is to support the top portion of the excavation in the overburden layer of the arc-shaped excavation area. It reduces the potential for sloughing of the overburden into the waste zone.

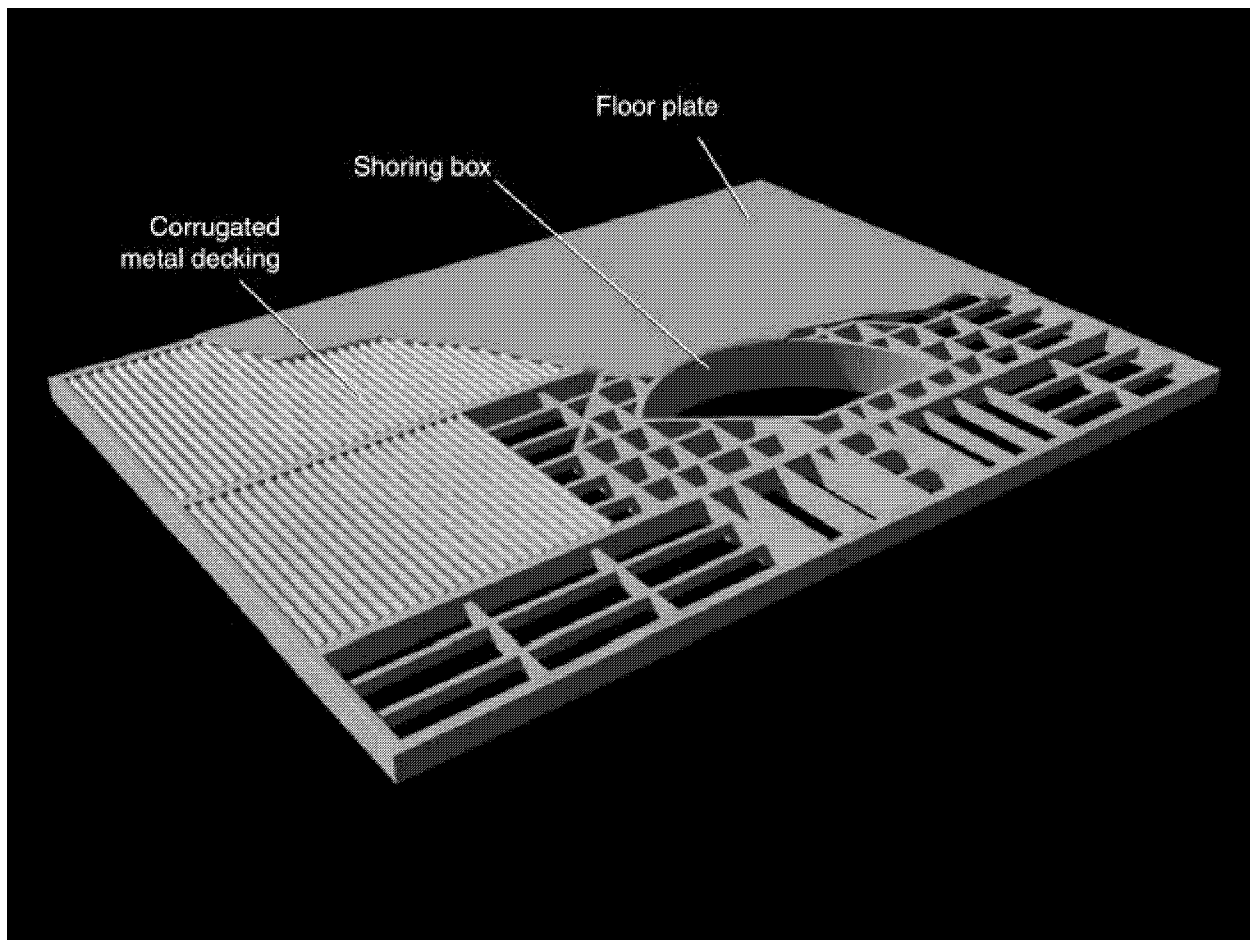


Figure 3-16. FFS is the working surface for personnel, and supports small forklifts and pallet trucks.

3.4.2 Retrieval Confinement Structure

The RCS is a prefabricated, modular panel structure that encloses the excavation area (see Figure 3-17) approximately $52 \times 28 \times 24$ ft high. It interfaces with the excavator and the PGS and is supported by the FFS. The panels, doors, windows and penetrations in the RCS are sealed to confine the waste retrieval area. The inner surface of the RCS is stainless steel.

The purpose of the RCS is to prevent the spread of contamination from the waste retrieval excavation to the personnel working areas and to the environment. It also provides an inner surface that is readily decontaminable.

The modular design of the RCS allows easier construction on the pit area.

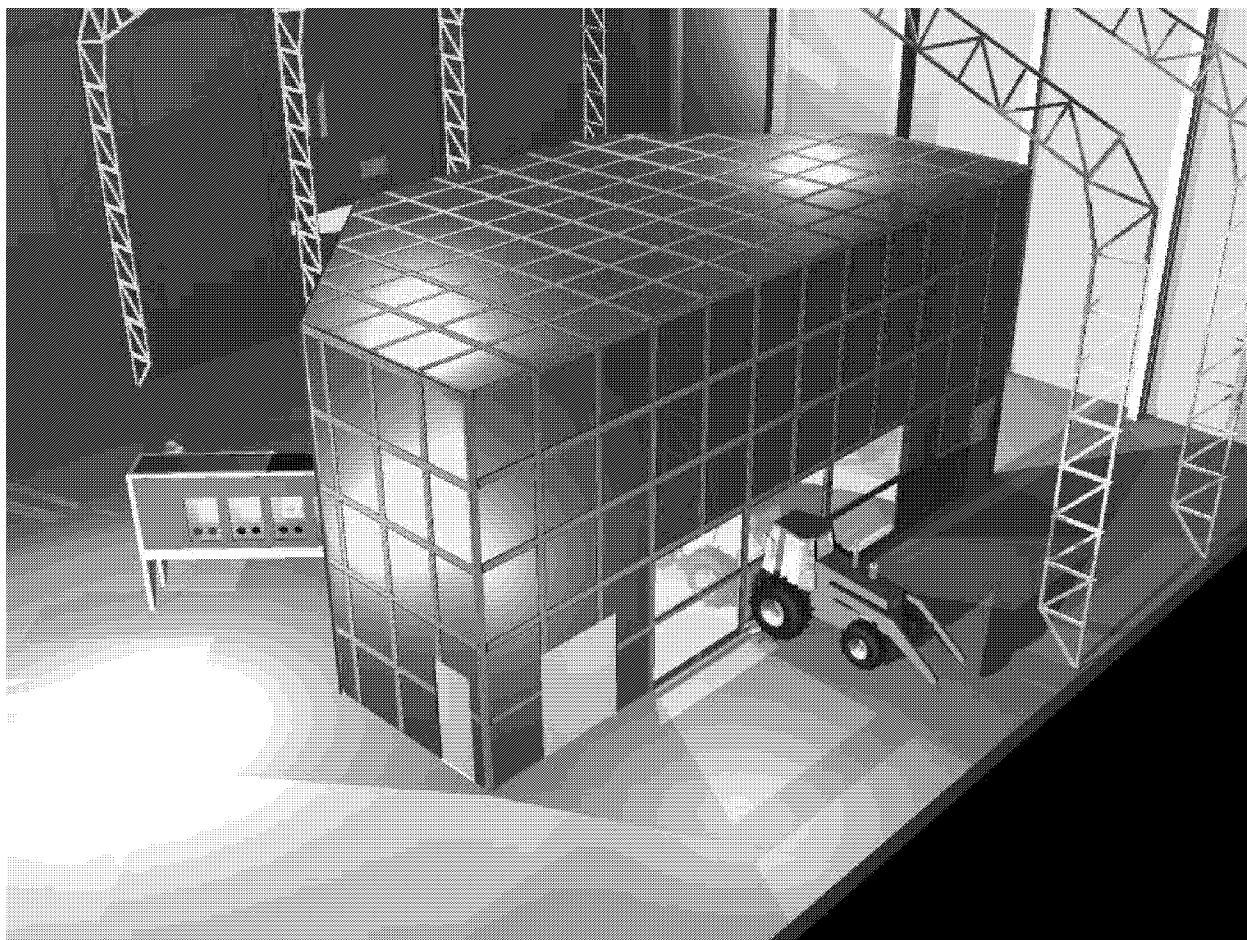


Figure 3-17. Retrieval confinement structure confines contaminants.

3.4.3 Packaging Glovebox System Structural Supports

The PGS is described in Section 3.5. This section describes the interface of the PGS and the RCS and FFS.

The gloveboxes are supported by structure frames that attach to the FFS. The frames are designed to resist the same loading as the other safety significant structures and components.

3.4.4 Weather Enclosure Structure

The WES is a commercially available fabric-covered structure. The architectural design of the WES is described in Section 3.3 of this document.

The WES is designed with a structural framing to resist loading from wind, snow, rain, and other weather-imposed loads. The framing also supports lighting, fire protection systems, heating units, electrical conduit, and other support systems.

The WES building supplier will provide the necessary structural analysis for the WES. Support requirements from the analysis will be used to ensure that the FFS can resist the WES loading.

3.4.5 Miscellaneous Structures

The miscellaneous structures are briefly described in Subsection 3.3. They are mainly relocatable structures designed to comply with the requirements of Appendix K of the AES. Sections of other codes and standards, such as the IBC and the *National Electric Code*, as applicable to temporary or moveable structures, may also be used for their design.

Any permanent structures, such as the fire riser building, are designed to comply with the IBC and other applicable design specifications and codes.

3.5 Process Equipment

The process equipment for the Glovebox Excavator Method Project

- Removes overburden soil and places it in soil sacks (pliable fabric sacks) for removal from the RCS
- Removes interstitial soil and waste zone material from the pit and transfers it to the PGS where it is segregated, sampled, and packaged into drums for transport to the storage area
- Performs fissile monitoring on some waste forms.

Process Equipment

- Simple equipment and systems
- Standard excavator, operated from its cab, performs excavation
- Safe—no entry into confinement during normal operations

The process equipment is divided into three functional areas: retrieval, waste transfer, and packaging. The process equipment, shown in Figure 3-18, consists of one retrieval system, three waste transfer systems, and three packaging glovebox systems. The excavator used for retrieval is a standard backhoe, with minor modifications for this application. The excavator cab is located outside the confinement for the safety of the operator. The design uses simple off-the-shelf equipment to the maximum possible extent for reliability and low maintenance. It is not necessary for workers to enter the confinement during excavation operation or during actual underburden sampling.

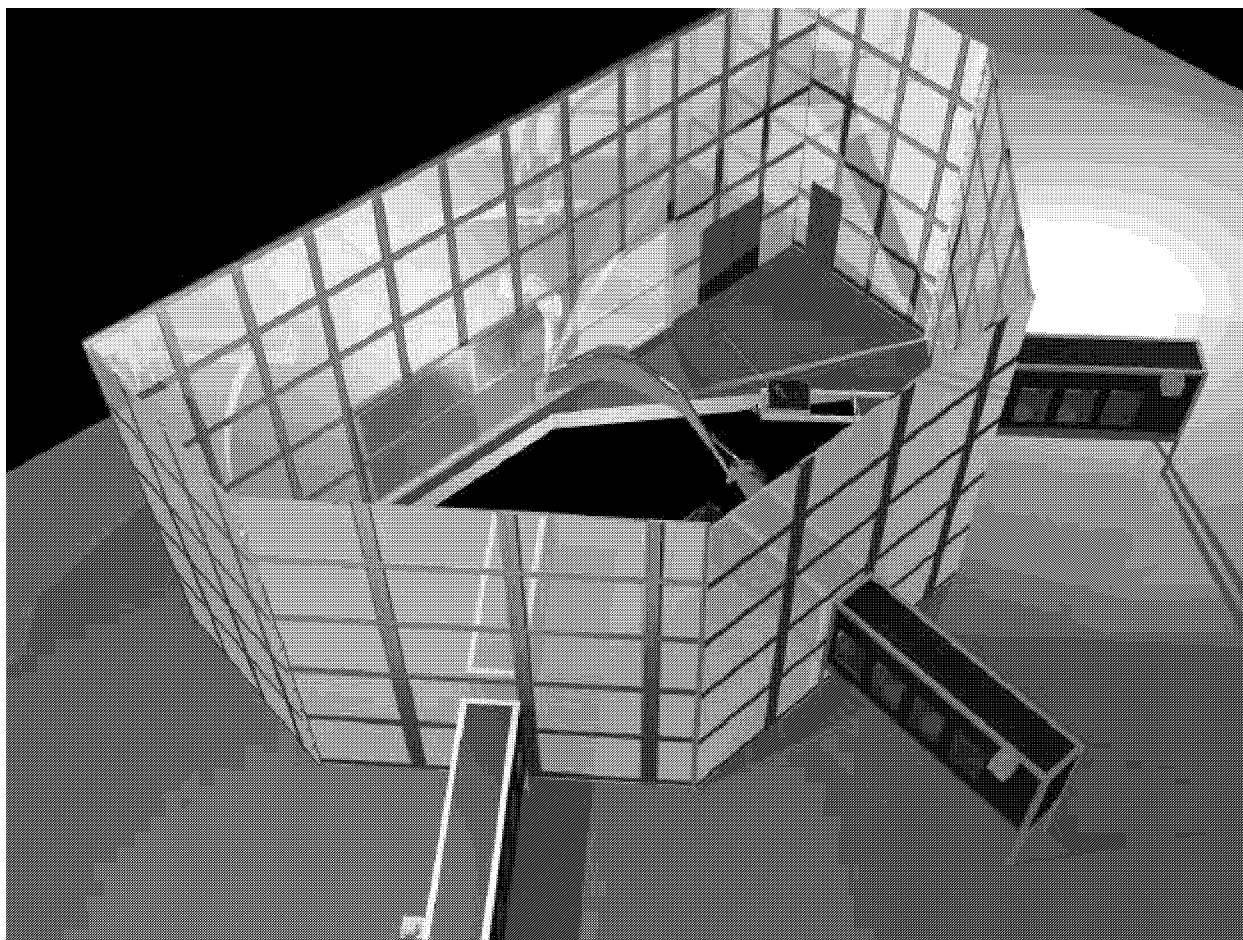


Figure 3-18. The process equipment offers a simple solution to retrieval and processing for waste zone material.

3.5.1 Retrieval Equipment

The retrieval equipment forms a simple system that reliably excavates material from the pit for subsequent packaging. The system consists of the excavator, end effectors, interfaces with the PGS and RCS, camera system, fuel system, and fire protection system.

Excavator. The excavator, shown in Figure 3-19, is a standard, off-the-shelf backhoe with the hydraulic arm inside the confinement and the cab outside the confinement to protect the operator. The excavator exhaust is routed to the outside of the WES.

A series of steel plates is added to the back end of the excavator frame to isolate it from the weather enclosure area. When combined with the flexible membrane discussed in the next section, they form a primary confinement seal, which is a continuation of the primary confinement boundary. Hydraulic bulkhead connectors are used in these steel plates to preserve confinement for the hydraulic

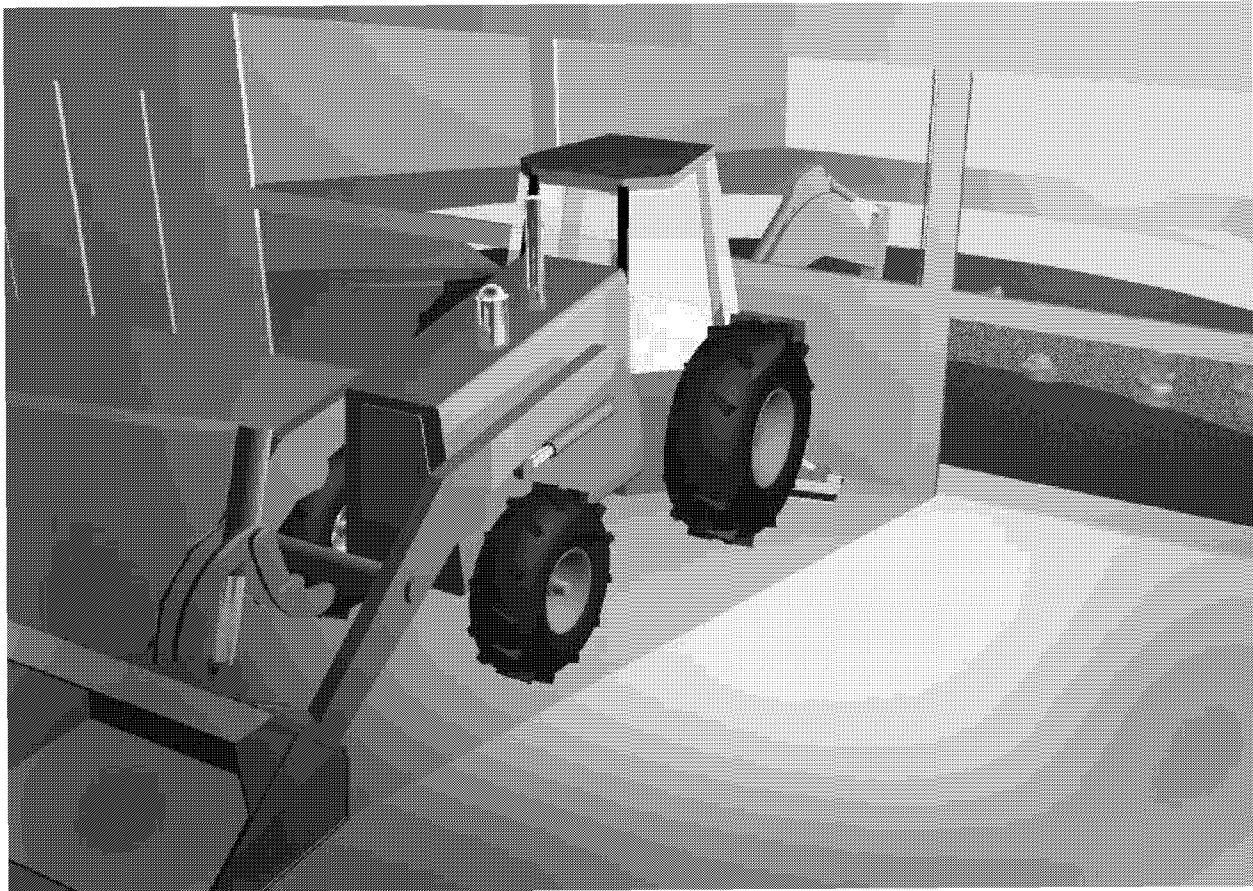


Figure 3-19. The off-the-shelf excavator uses standard excavation methods.

hoses. The hoses and fittings will be proof tested prior to installation and will be leak checked after installation.

The excavator's cab contains all the controls for the arm and its end effectors. The operator views the excavation arm through windows in the confinement structure. The arm consists of a fixed-length boom, an extendable stick, and a remotely-operated end effector coupling. The coupling is used to attach and detach the end effectors from the cab. The excavator end effectors can span a minimum of 25 ft from the excavator confinement wall, which is well within the requirement to excavate a 20-ft radial swath, 145 degrees wide. The excavator can lift loads in excess of 1,000 lb from any boom and stick position in the pit. The excavator axles are mounted on rigid supports that are tied to the FFS. This prevents excess excavator motion during operations and minimizes motion of the flexible membrane discussed below.

End Effectors. There are two primary end effectors, a split digging bucket, and a hydraulic hammer attachment. The excavator has an automatic pin-grabber attachment that remotely couples to either of these end effectors. The end effector that is not in use is placed in the 35-degree swath of the pit that is not excavated. These tools are shown in Figure 3-20.

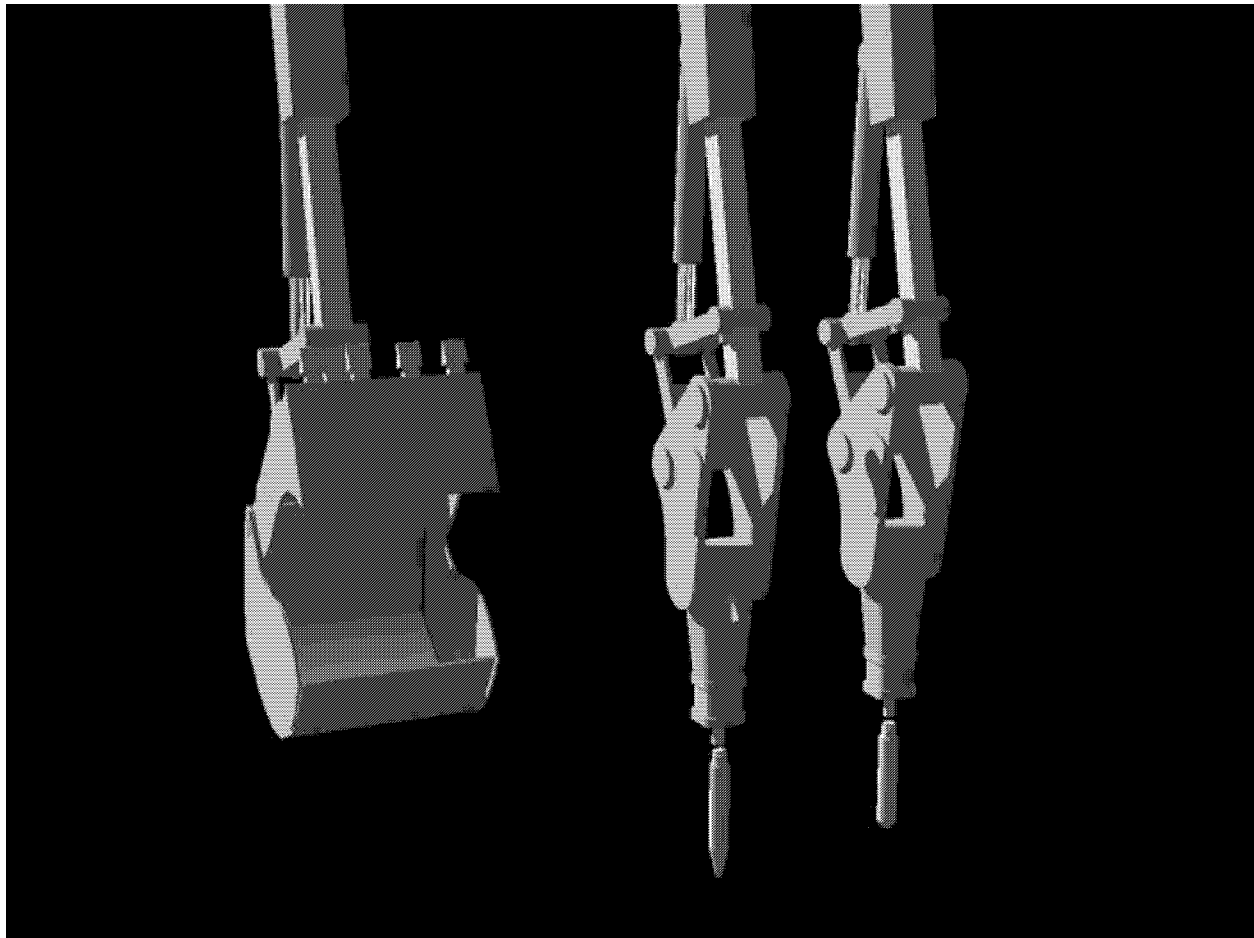


Figure 3-20. End effectors provide flexibility to retrieve and sample waste zone material.

The split digging bucket is used for digging overburden and removing waste zone material, which it delivers to the RCS carts. The bucket is split into two halves that can separate along its center seam and open in clamshell fashion so that the excavator can grapple and pick up large items such as intact drums or large concrete pieces. Bucket separation is controlled by a valve operated from the excavator control panel.

The hydraulic hammer end effector has core samplers attached to its ram section for sampling the underburden. The hammer drives the samplers to approximately 2 ft or to refusal. After a sample is taken, operators remove the sampler through gloveports in the northeast corner of the RCS and replace it with a new sampler. The sample and sampler are then bagged out of the RCS. This process is repeated until all eight underburden samples are obtained.

Excavator's Interface with RCS and PGS. Figure 3-21 shows the excavator's interface with the RCS. A flexible membrane spans the gap between the excavator frame and the penetration in the RCS wall. A steel angle is welded around the outside of the excavator frame that is next to the RCS wall. A flexible membrane is attached to this angle and to the RCS wall. This seals the excavator frame to the RCS wall and, together with the excavator frame modifications discussed above, completes the confinement in the excavator interface. In addition, a torturous path against flame propagation to the flexible membrane is provided.

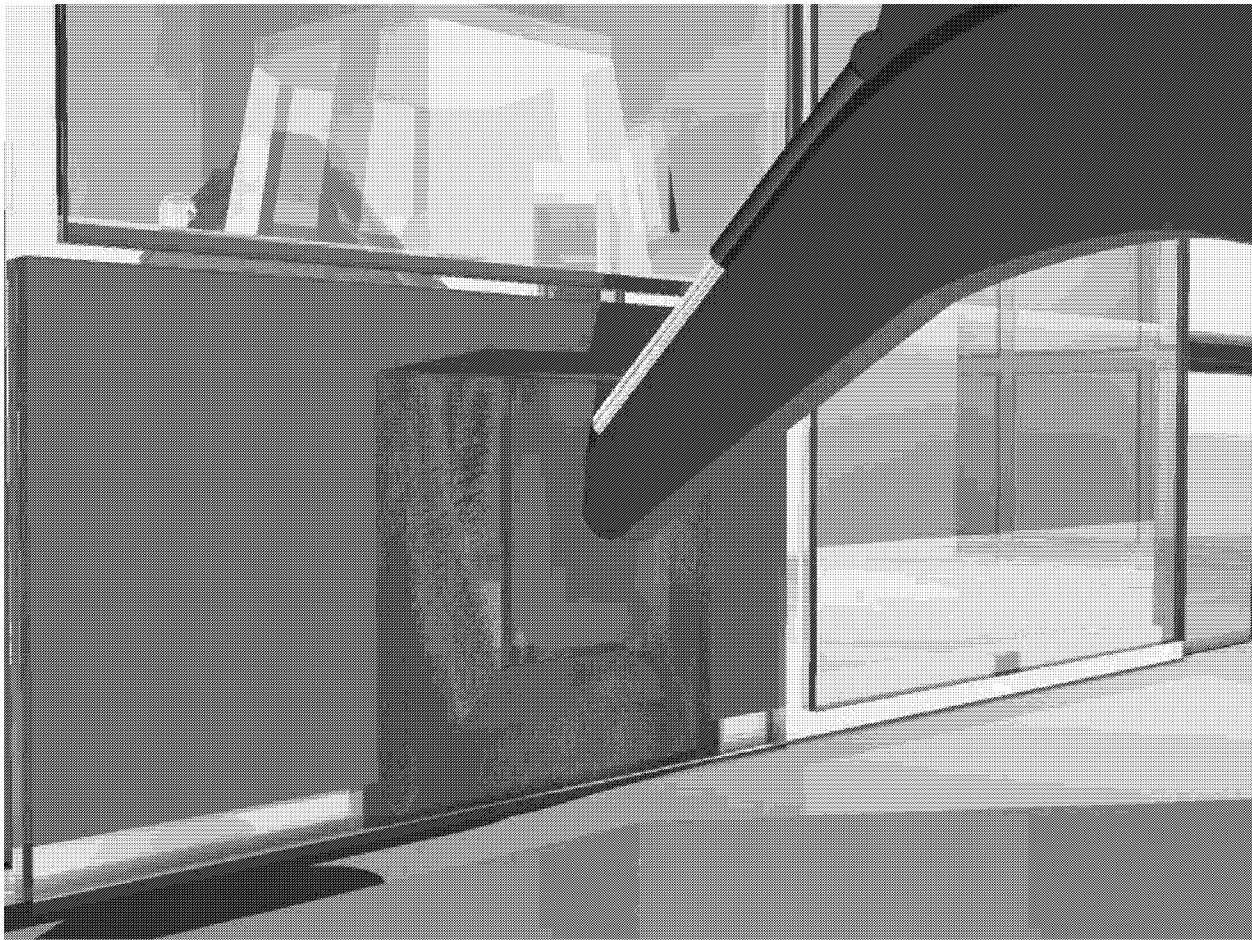


Figure 3-21. The excavator seal system seals the excavator to the RCS.

The excavator's interface with the PGS is shown in Figure 3-22. The excavator delivers waste zone material to the waste transfer cart, which is located at the end of the glovebox track system approximately 6 ft inside the RCS. The excavator's split digging bucket delivers loads ranging from small amounts of interstitial soil up to intact 55-gal drums.

Excavator Camera System. A monitor in the cab of the excavator displays the view from any of three high-resolution color cameras placed around the RCS to give a view of the pit in the blind spots that the operator cannot see from the cab. The camera positions are shown in Figure 3-23.

Excavator Fuel System. The excavator operates on diesel fuel. Fuel is supplied via a 55-gal drum that will be hauled to the excavator tank. Fuel is pumped by hand from the drum to the fuel tank. The drum will then be removed to reduce the available diesel fuel in the area. A tank of fuel supplies the excavator with approximately 19 hours of normal operation. A curb around the excavator contains any spilled or leaked fuel or hydraulic fluid.

Excavator Fire Protection System. The excavator's engine compartment has a factory-installed fire suppression system that detects and suppresses fuel or hydraulic fluid fires that originate in the engine compartment of the excavator.

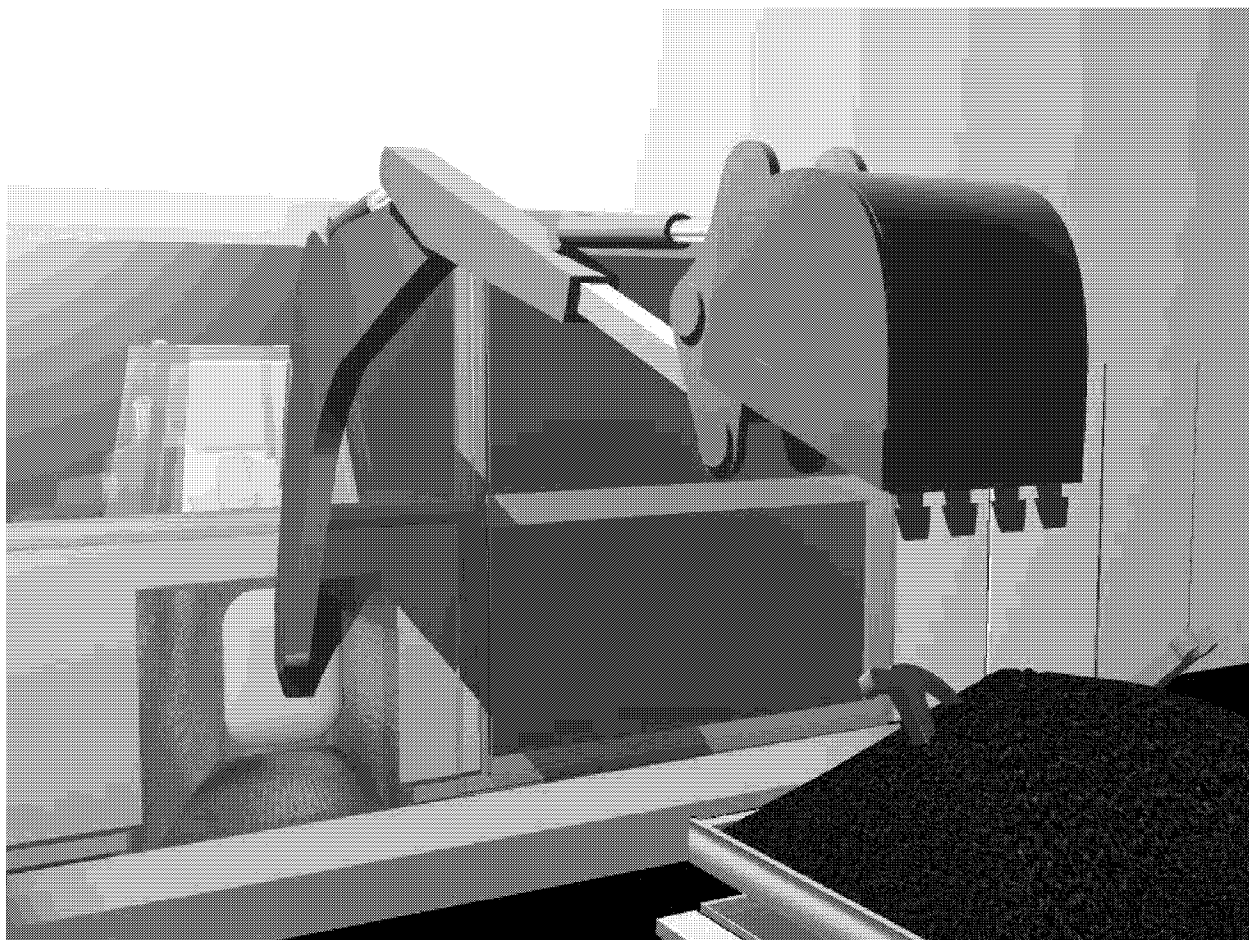


Figure 3-22. The excavator can easily load the waste transfer cart.

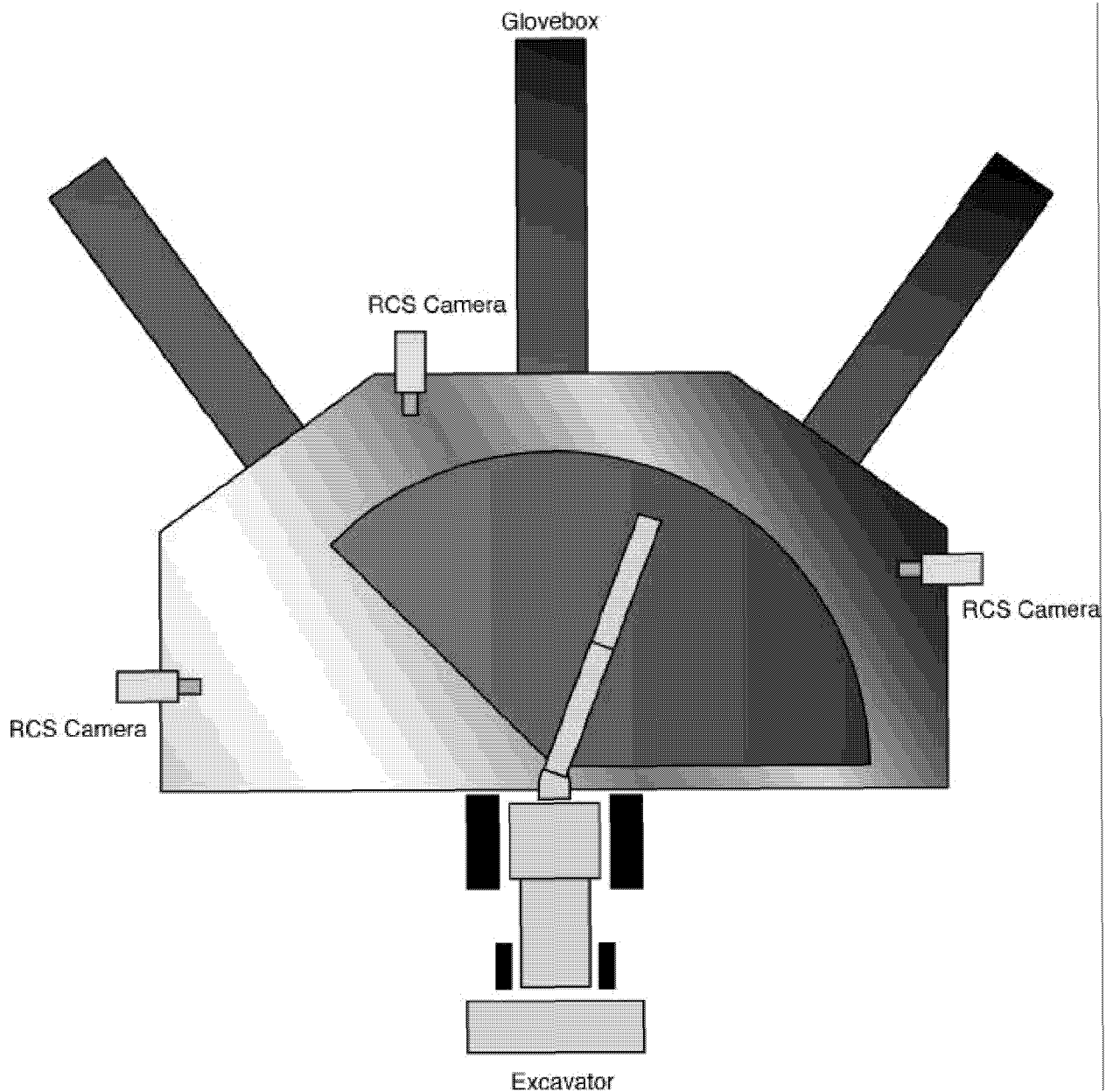


Figure 3-23. The excavator camera system affords the operator views of all operations (camera locations are approximate).

3.5.2 Retrieval Equipment Operation

The retrieval equipment provides efficient excavation of the overburden and waste zone material as well as sampling of the underburden.

Overburden Removal. The overburden is excavated inside the RCS confinement. The excavator, working through the confinement wall, excavates the first 3.5 ft depth of overburden in a circular section that is 145 degrees wide and 20 ft in radius. Figure 3-24 shows the overburden excavation.

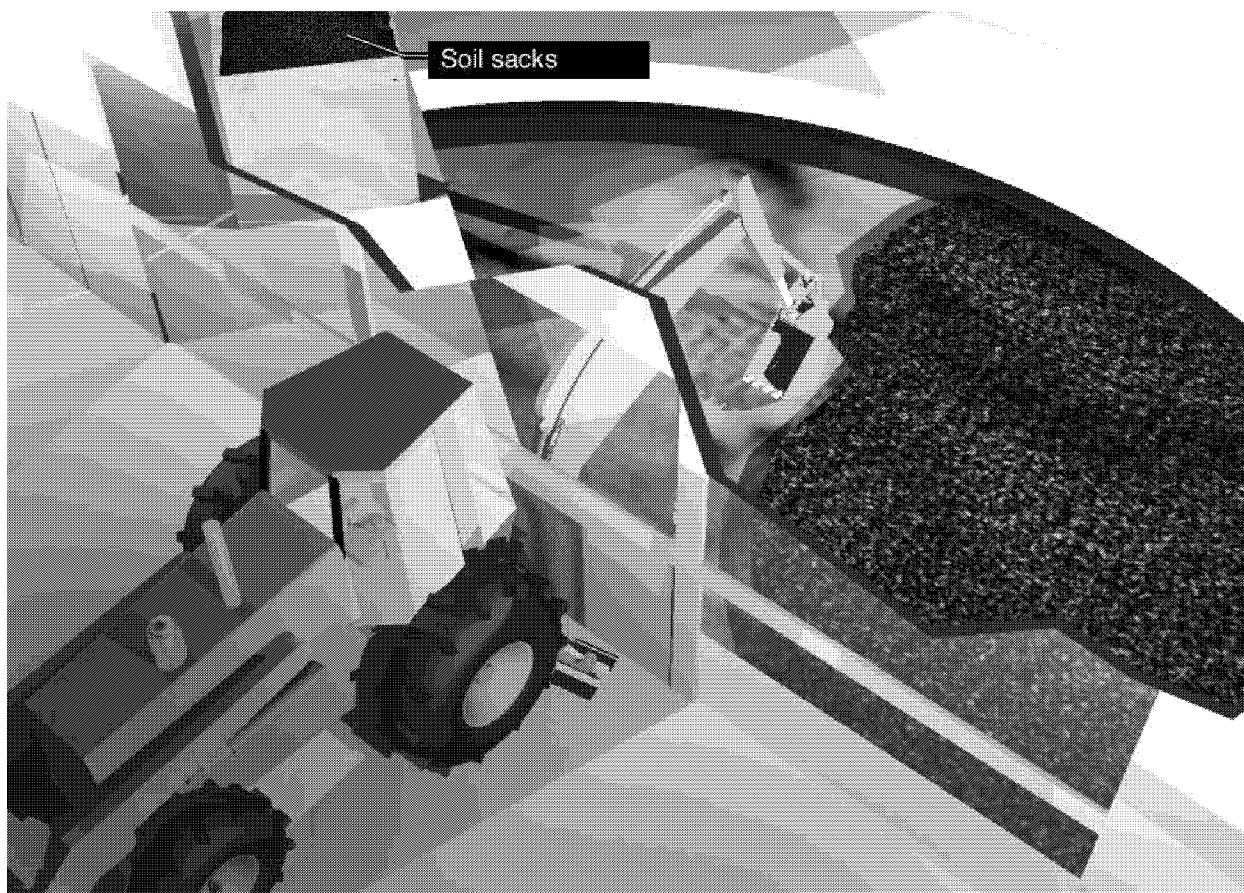


Figure 3-24. The excavator removes overburden and places it in soil sacks inside the RCS.

Excavated soil is placed in $4 \times 4 \times 4$ -ft soil sacks, which are staged in the 35-degree area on the FFS that is not excavated. The soil sacks are removed from the confinement and stored outside of the WES for later return to the pit.

Waste zone material Removal. The waste zone material is removed after all of the overburden has been removed. Waste zone material excavation is shown in Figure 3-25. The split-bucket end effector excavates waste and interstitial soil and places it on the glovebox waste transfer cart; excavated drums are moved using the bucket in the split mode as a clamshell tool. Excavated waste zone material is placed on the waste transfer cart in the confinement for transport into the PGS.

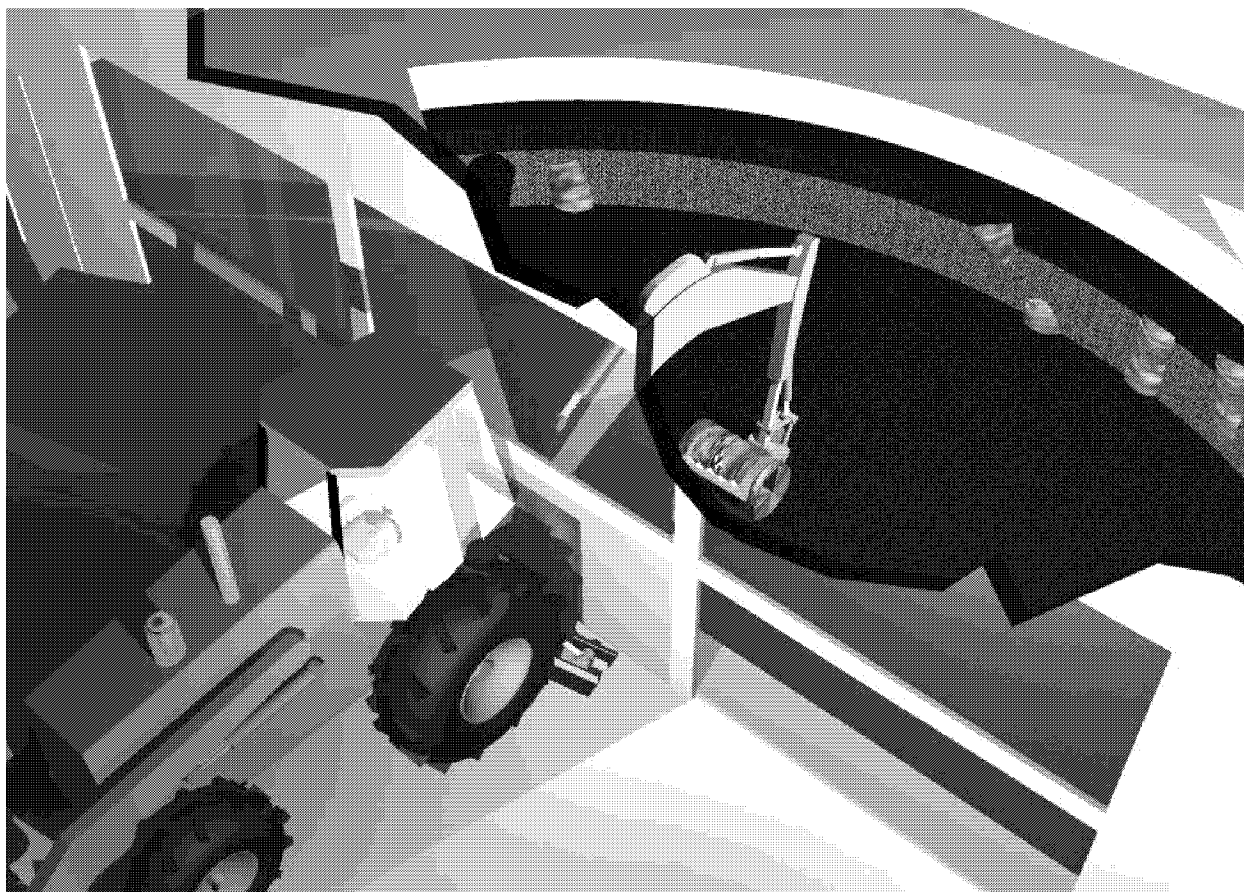


Figure 3-25. The excavator removes the waste zone material down to the underburden.

Underburden Sampling. Once the waste zone material has been removed, and workers determine that the underburden has been reached, excavation stops and underburden sampling begins. Figure 3-26 shows underburden sampling.

Prior to sampling, the split bucket is placed on the 35-degree laydown area and remotely detached. The hydraulic hammer is then remotely attached using the automatic pin grabber at the end of the excavator stick. The hammer is fitted with the soil sampler to take a 2-in. diameter by 24-in. long sample from the underburden. Hydraulic lines on the hammer are connected to the excavator boom lines using glove ports near the northwest corner of the RCS. The excavator operator then positions the hammer over the area to be sampled and energizes the hammer to drive the sampler and obtain the sample. The hammer and full sampler are then placed at the staging area, and personnel enter the RCS to remove the sampler and replace it with a new sampler. The process is repeated until eight samples are obtained.

Pit Filling. After the underburden has been sampled, the overburden is returned to the pit. The soil sacks of overburden will be placed by forklift into the pit or staged in the 35-degree floor area and dumped in the pit by the excavator. The excavator will break the sacks in the pit and spread the overburden in the pit. After the overburden is returned, the remaining void will be filled with a weak grout.